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Some Ecological Effects of the Oil Industry on Farmland in East Central Illinois

Dale E. Fruendt
Eastern Illinois University

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Some Ecological Effects Of The Oil Industry

On Farmland In East Central Illinois

(TITLE)

BY

Dale E. Fruendt

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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Abstract

Between June, 1970 and July, 1971 a two square mile area in East Central Illinois served as a study area for the effects of the oil industry on farm land. Observations were made on several farms concerning the activity of oil companies and interviews with farmers were held. Two areas of farmland were given special attention. One was a clover field where salt water had flooded a portion of the field. The other area was a corn field where oil had flooded approximately eight acres of land. Random samples of invertebrates were taken in both of these areas as well as in control portions of the fields. Soil analyses were also made to determine organic material present, sodium soil test value, and soluble salt in both areas.

In the area where oil had been spilled the organic material present was higher according to soil analysis. The salt content was also higher because oil and salt water are produced simultaneously. In the area where salt water flooded the ground the sodium salt test value and the soluble salt figures increased tremendously.

Oil itself is not toxic. However, in soil it prevents plants from obtaining sufficient moisture and air for growth. Oil, though, was found to be less dangerous as a pollutant than salt water. It can be decomposed by fungi and bacteria whereas salt remains in the soil and has a plasmolyzing effect on plants. Both types of pollution

disrupt natural food chains because in either case the primary producers are not present.

The economic effect of the oil industry in the farm area is also discussed with special reference made to areas which farmers cannot use because of the presence of oil industry equipment. The oil industry has another effect on the farmers because many of the farms' drainage systems are disrupted due to the activities of the oil industry.

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Introduction and Literature Review.

"Oil is perhaps the most widespread of any pollutant in the world's waters - the rivers, the estuaries, and the oceans", according to an article in Enviromental Science and Technology (7). "Each day 15 billion barrels of oil are moved and by 1980 the number is expected to increase to 18 billion. Each year an estimated two million tons of oil enter the oceans from tanker cargoes. Last year there were over 10,000 spills."

In recent years the occurrence of oil pollution in specific ecosystems has received much publicity. Published reports of the effects of oil pollution are extensive (27). A survey of the literature on oil pollution indicates that workers have concentrated their efforts on the legal aspects of oil spillage (9, 19, 23), the biological effects of oil spillage with reference to particular organisms (1, 2, 3, 5, 6, 8, 10, 11, 15, 16, 20, 22, 25, 28, 30, 31, 33), and the effects of oil pollution from the recreational and aesthetic standpoints (4, 7, 14, 18, 21, 24, 32).

Molotch (23) discussed the legal aspects of oil spillage in reference to the Santa Barbara oil incident. The Santa Barbara coast, traditionally a tourist attraction, was flooded with oil in January of 1969. For 15 years, Santa Barbara's political leaders had tried to prevent such an incident by interrupting oil operations within the three mile limit of state waters. However, they could not stop operations in federal waters beyond the three mile limit. The oil companies had paid a record $603 million for their lease rights and neither they nor the federal government bore any significant legal responsibility toward the localities which those lease rights might endanger.

Legislation to ban drilling after the oil leak was introduced by Senator Alan Cranston in the U.S. Senate and Representative Charles Teague in the House of Representatives. Joint suits for $1 billion in damages were filed against the oil companies and the federal government by the city and county of Santa Barbara. These moves were counteracted by the oil industry in the form of lobbying in the U.S. Senate and House of Representatives.

Secretary of Interior Walter Hickel, called a halt to oil operations immediately after the initial eruption but only a day later he ordered drilling and oil production to be resumed. Within 48 hours, public pressure caused him to reverse his position and ordered another halt to drilling. After a few weeks oil operations were again started. As a result of the large controversy, the federal government did produce new regulations that specify that oil companies would henceforth be financially responsible for damages resulting from pollution mishaps.

The legal aspects of inland oil production as it affects the land owner have not been as well defined. In the area under study, substantiated data shows that farmers seldom receive payment for crops damaged due to oil operations on their farms. Holmes and Blume (19, 9) in personal interviews with the author have stated that once the oil companies have signed a lease for a farm, "they do as they please." Oil and salt water leaks occur, but damages are seldom paid. It seems to depend upon who the producer is. Some are more conscientious than others. In most cases, damages to farms are small enough that it would be too costly to take court action against the oil companies to try to collect payments.

In most studies of oil pollution, the biological effects of oil on a particular organism are studied. The most popular organisms studied seem to be birds and fish, although other groups have been studied.

The effect of oil on plankton and other microfauna was studied in the Muddy River in Massachusetts. McCauley (22) found that an oil film on water prevented more oxygen from becoming dissolved in the water, but not enough oxygen was excluded to destroy the developing plankton. The oil film gradually diminished but sedimentation of the oil in the water produced an oily sludge on the river bottom. A low biochemical oxygen demand was consistently correlated with high concentrations of oil in the sludge area of oil pollution, indicating a slow decomposition of sludge oil by microorganisms. The toxic effect of the oil was pronounced on the microfauna of the sediments and on the plankton organisms. In the sediments, Gammarus, Agrion nymphs, and Dugesia were unable to tolerate conditions in the region of oil pollution while

Tubifex, Chironomidae, Nematoda and Hirudinea types remained.

Other invertebrate organisms were studied in Puget Sound (2) where an oil spill occurred during the loading of a giant oil tanker. Two spots were chosen for study. One was near the spill and a control area not affected by the spill was selected. In the first area, 48 species of invertebrates were collected and the mortality of these invertebrates ranged from 30% to 100%. Only two species of periwinkles were apparently not affected by the oil. Among the hardest hit were brittle stars, polychaetes, nemerteans, chitons, hermit crabs, and limpets. It was also noted that animals at higher intertidal regions were more seriously affected than those at lower intertidal regions, possibly because they were coated with oil longer.

The number of oil-caused fish kills is high. In a publication prepared by the Office of Public Information of the Federal Water Pollution Control Administration (3), several incidents of fish kills were cited. The highest number of fish killed in one incident was 50,000. The bulletin also states that the largest single cause of fish kills from years 1960-1968 was sewerage systems (6,181,873) and the next largest was the petroleum industry (4,272,962). All other sources of pollution combined were under 4,000,000.

In a study made by Gooding (16) of the tanker R.C. Stoner, over 2,500 kg. of inshore reef fishes were killed. Hunt (20) studied the effect of oil pollution in the Great

Lakes. Mortality of small bullheads and catfish was caused by oil in Plum Creek Bay area at the west end of Lake Erie.

The actual effect of oil upon fishes was studied by Wiebe (33). From his research, it was found that oil can affect fish in two different ways. One, oil gathered on the surface of the water prevented the exchange of gases between the water and the atmosphere and thus caused an oxygen deficiency in the water which resulted in the suffocation of the fishes. Secondly, he found that the oil formed a film over the gill filaments of fishes and other aquatic animals and prevented the exchange of gases (O_2 and CO_2) between the blood and the water. Again suffocation would result.

Reports of the effects of oil pollution on birds are even more numerous than the effects on fishes. For every major oil disaster at sea, there are reports of loss of birds due to oil. Tottenham (30) reports that the effect of oil on birds is that they are partially immobilized by the heavy substance on their feathers. If they preen the oil from their feathers, toxic substances in the oil will kill them. If the birds are far enough out to sea, congestion of the lungs, exposure, and starvation are the killers. Oiled birds may be cleaned with fuller's earth or prepared chalk.

In the literature, there has been some discussion as to whether birds are attracted to oil slicks or not. Peterson (25) has suggested that since oil quiets waters, birds would be attracted to the shiny quiet patch of oil in the sea.

If they land in it the oil serves to weight them down, disable them from flying, and the feathers lose their waterproof quality which allows the sea water to reach their skin, thus chilling them. Often birds die of pneumonia but in warm climates death is usually slow.

Bourne (10) on the other hand disagrees. In an observation made May 18, 1968, he observed a coastal vessel spill oil in a dense band from 5 to 10 feet wide. In their normal swimming activities, some birds swam into the oil but dived as soon as they touched it. Birds of three species flying above the oil were not attracted to it.

The number of birds killed due to oil are staggering. For example, Hunt (20) points out that for any one year from 1948 through 1960, as many as 10,000 ducks were killed each year on the Great Lakes. As many as 5,000 ducks were killed due to oil on Lake Ontario alone in 1960.

The effect of oil on plants is also well documented. Bellamy (8) and his associates studied the effect of oil on littoral and sublittoral ecosystems after the Torrey Canyon disaster. In this study he found that oil had altered the balance of ecosystems dominated by attached macrophytes due to the destruction of grazing organisms. The main effect was in the littoral ecosystems where the herbivores play an important part in the maintenance of the balance of primary producers. The effect was caused by an oil-detergent combination.

The effect of oil on terrestrial plants has also been studied. Plice (26) has stated that crude oil can "sterilize" and prevent plant growth for various periods of time. In oil spills over farm land, penetration of oil is worse in dry weather than in wet seasons. The damage of oil is due mostly to the prevention of plants from obtaining sufficient moisture and air and from ramifying the roots; very little is due to toxicity as such. Oil damaged fields are best reclaimed by cultivation. Crude petroleums are converted to soil organic matter by bacteria and fungi.

The effects of oil pollution from the aesthetic and recreational viewpoints are best shown through pictorial documents. Hicks (18) and Fisher and Charlton (14) have done this. These reports, although not deeply scientific, serve their purpose in enlightening the general public of the dangers of oil pollution. These types of publications help arouse public interest and will hopefully help pass legislation which will help prevent the pollution of seas and fresh waters by oil.

In the spring of 1970, Conlin and Platt (13) reported the oil pollution of Riley Creek near Mattoon, Illinois. This was the result of a break in an oil pipeline in that area. Casual observation showed that this spillage was but one instance of the harmful effect of the oil industry on a community. More detailed observations revealed that in addition to the water pollution, the oil industry has had a harmful effect on the land and crops of the area.

The purpose of this study is to provide a report of some damaging effects of the oil industry on the ecology of the farming community in East Central Illinois.

<u>Materials and Methods</u>. Observations were made over a two square mile area north of Mattoon, Coles County, Illinois, from June, 1970, until July, 1971 (Fig. 1). The effects of oil and salt-water spillage in Riley Creek as well as on the surrounding cropland were noted during this time.

Riley Creek orginates from a drain tile on the Oliver farm (Fig. 1) This tile underpasses the 19th Street Road one mile north of Mattoon, Illinois. Riley Creek runs through farm land planted in corn and soybeans. When first studied, the creek was approximately twenty-five feet wide for most of its length, and approximately three feet deep in most places. Riley Creek was studied from its source to approximately three-quarters of a mile downstream.

Observations over the Oliver, Blake, Taylor, and Homan farms (Fig. 1) showed active and inactive oil wells. Two areas of farmland were given special attention. One area was on the Homan farm where salt-water had flooded a portion of farmland (Fig. 19), and the other on the Blake farm where oil had flooded 7 to 8 acres of corn field (Figs. 14, 15, 17). Random samples of invertebrate populations were taken in these areas by using a one square foot sampler. Ten random samples were taken directly in each area flooded and the number of organisms found in each group represented was recorded. Also, ten samples were taken in each locale around the periphery of the area affected by the oil or salt water spill. Again, the number of organisms in each order repre-

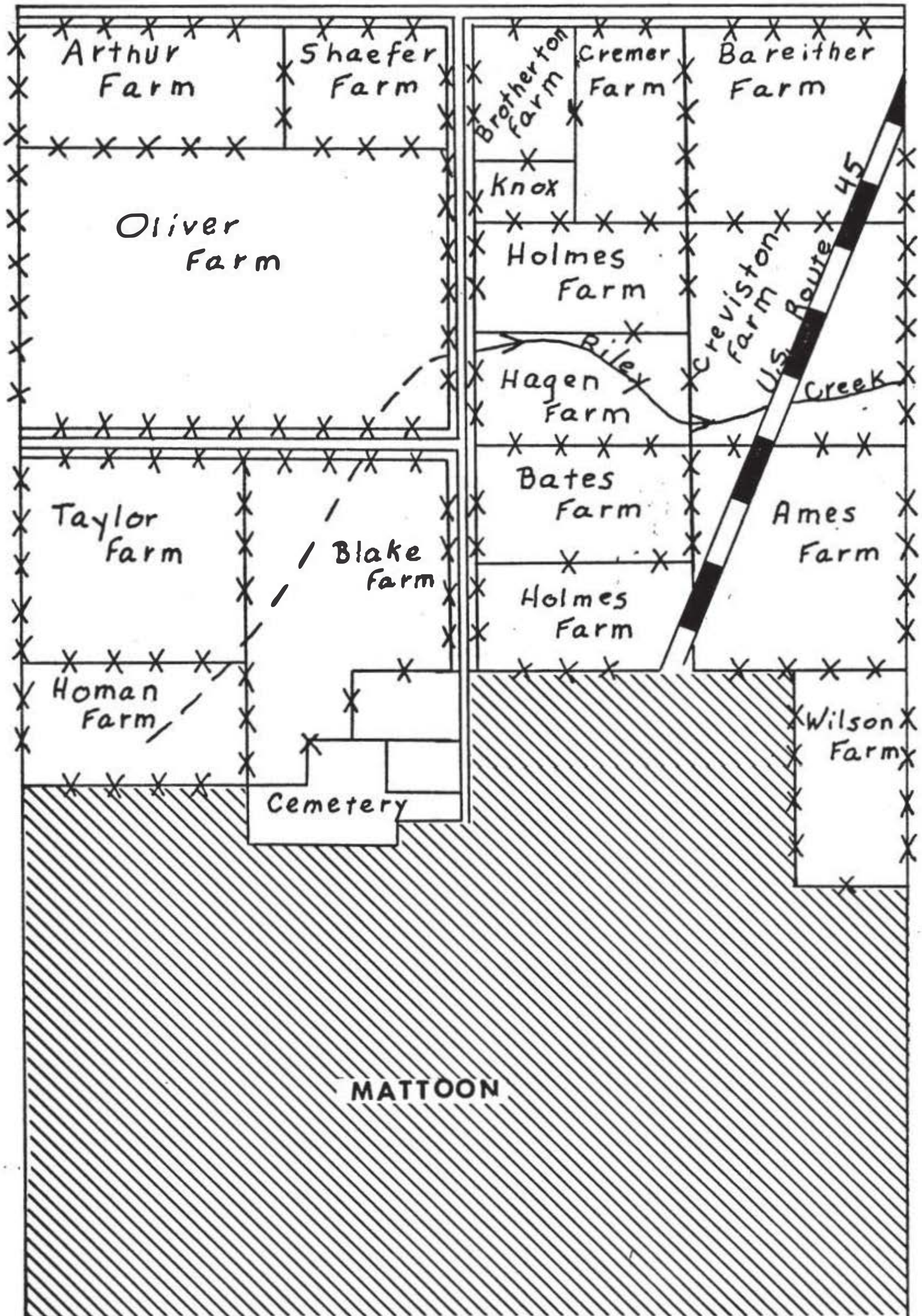

Fig. 1. Map of Study Area

Legend

Scale: 2½ in. = 1 mile

County road

Farm boundry

Drain tile

Riley Creek

U. S. Route 45

sented was recorded.

Soil samples were also taken from five locations within the study area. These samples were taken to the office of Dr. Ted Peck in the College of Plant Sciences at the University of Illinois. Here the samples were analyzed for oil and salt content. The samples were taken from the following locations.

1. Bottom of Riley Creek.
2. Area of corn field soaked with oil.
3. Area of corn field not soaked with oil.
4. Area of clover field soaked with salt water.
5. Area of clover field not soaked with salt water.

Interviews were conducted by the author with farmers, representatives of the oil industry and the state oil inspector to determine frequency of such occurences, economic factors, and other pertinent information about the oil industry. Sample questions asked in the interviews along with brief summaries of answers are presented in Appendix I. The affected areas were photographed.

During the summer of 1970, gas chromatography studies were conducted on oil scum samples obtained from Riley Creek in an attempt to determine the precise origin of the oil in the creek.

Results.

I. Riley Creek. The oil pipeline break which occurred on the Homan farm resulted in a large oil slick on the surface of Riley Creek (Figs. 3-5). This oil slick extended for about a quarter of a mile from the origin of the creek. In an attempt to control the spread of oil, a wire fence was placed across the creek by the oil industry representatives. The fence was intended to trap brush and other debris which would in turn be burnt off. Although the presence of the fence did allow for the easy burn-off of much of the oil, a number of damaging side effects resulted. Heavy siltation occurred in the creek from its origin to the area where the wire fence was placed (Fig. 6). Siltation caused heavy vegetation growth in many parts of the stream (Fig. 7). This overgrowth, which impeded the movement of water in the creek, was attributed to the silt build up, since that part of the creek immediately downstream from the fence had no overgrowth and appeared normal (Fig. 8). Heavy siltation in some areas caused the partial blockage of the drainage tile system in the surrounding farm land (Fig. 9) The effects of poor drainage on the land were observed in the stunted appearance of the soybeans in the affected land (compare Figs. 10 and 11).

The removal of the oil from the creek by burning resulted in fairly heavy fire damage to the bordering trees and shrubs (Figs. 12 and 13).

Shortly after the oil leak occurred, many dead fish were seen in the water (13). Two years later, more dead fish could still be seen in the creek. The odor of oil was evident and an oil film could be observed on the water.

II. Farmland. Drain tile systems in the farmland of the area have been damaged on many occasions due to the road building by the oil companies. Using leasor's rights, the oil companies came into the area, and in their search for oil, built roads through the farmland with total disregard for the drain tile systems in the area. Damaged tiles are seldom repaired by the companies. Unused machinery can be seen in the area (Figs. 22 and 23). Attempts by farmers to have the oil companies remove old machinery have been unsuccessful.

A brief summary of the effects of oil and salt water leakage on farmland can be seen in Tables I and II. Invertebrate populations were drastically reduced in areas where leaks occur (Table I). The leakage of oil resulted in fairly extensive damage to one farmer's corn crop. As much as eight acres of the Holmes plantings have been destroyed in a single stand, and smaller damaged areas can be observed (Figs. 14-17). The soil sample from this oil soaked area shows a high organic material content, a high sodium soil test value, and a high soluable salt content as compared to another area of the corn field (Table II).

An area on the Homan farm where salt water leaked out of a pipe is incapable of supporting plant life (Fig. 19) and only seven insects were found out of 10 one square foot sample tests made there (Table I). Soil analysis of this area shows a sodium soil test value of 13,203 ppm and soluble salt volume of 55 millimoles/cm^3 (Table II).

III. Gas Chromatography. Gas chromatography proved to be unsuccessful in determining the origin of the oil slick because the more volatile substances evaporated from the oil in the creek and only the heavier hydrocarbons remained.

Table I. Organisms collected from 4 locations in study area using a square foot sampler. Ten samples were taken from each area. These samples were collected approximately ½ year after the corn field was flooded with oil and four years after the salt flooded the clover field.

Area of corn field soaked with oil		Area of corn field not soaked with oil		Area of clover field soaked with salt water		Area of clover field not soaked with salt water	
Arachnoidea	1	Arachnoidea	2	Homoptera	7	Arachnoidea	65
Coleoptera	2	Coleoptera	44			Coleoptera	83
Diptera	3	Diptera	5			Diptera	8
Lepidoptera	2	Lepidoptera	1			Lepidoptera	5
Hymenoptera	2	Hymenoptera	2			Hymenoptera*	1,404
		Orthoptera	1			Homoptera	43
						Orthoptera	8
						Hemiptera	28
Total	10	Total	61	Total	7	Total	1,642

* The large number of Hymenoptera found here is due to finding several colonies of ants.

Table II. Analysis of soil samples taken from 5 locations in study area. These samples were taken ½ year after the corn field was flooded with oil, 4 years after salt flooding in the clover field, and 2½ years after the creek was flooded with oil.

	Organic Material	Sodium soil test value	Sodium Salt
Creek bottom near origin	3.8%	120ppm	.5 millimoles/cm^3
Area of corn field soaked with oil	4.6%	2,430ppm	4.0 millimoles/cm^3
Area of corn field not soaked with oil	3.1%	80ppm	.3 millimoles/cm^3
Area of clover field soaked with salt water	2.9%	13,203ppm	55.0 millimoles/cm^3
Area of clover field not soaked with salt water	3.9%	80ppm	1.4 millimoles/cm^3

Fig. 2 Origin of Riley Creek

Fig. 3 Riley Creek--Spring, 1970
Oil Scum on Water

Fig. 4 Brush and Floating Debris
Stopping Oil

Fig. 5 Riley Creek--Spring, 1970
Oil Scum on Water

Fig. 6 Riley Creek--Summer, 1971
Showing Silt Build-up

Fig. 7 Riley Creek
Showing Heavy Vegetation

Fig. 8 Riley Creek Seen Downstream from Obstruction

Fig. 9 Partially Submerged Field Tile from the Hagen Farm

Fig. 10 Beans Stunted Due to the
Improper Draining of the Field

Fig. 11 Healthy Stand of Soybeans in
a Well Drained Area of Field

Fig. 12 Fire Damage to Trees
Summer, 1971

Fig. 13 Fire Damage to Trees
Summer, 1971

Fig. 14 Corn Severely Damaged Due to an Oil Leak.

Fig. 15 Corn Severely Damaged Due to an Oil Leak

Fig. 16 Corn Damaged Due to Oil Leak

Fig. 17 Close up of Corn Standing in an Oil Soaked Field

Fig. 18 Separating Tanks on Farmland

Fig. 19 Barren Area Caused by a Leak in Salt Water Line

Fig. 20 Pipe Carrying Salt Water from a Separating Tank to Brine Pit in Farmland

Fig. 21 Brine Pit in Farmland

Fig. 22 Unused Oil Rigging

Fig. 23 Miscellaneous Oil Tanks and Pipes

Discussion. That oil exerts a harmful effect upon fish when it gets into streams has long been recognized. The deleterious effect of crude oil and lubricating oils on fish and other aquatic organisms has been attributed to the fact that oil on the surface of the water prevents the exchange of gases between the water and the atmosphere. This causes an oxygen deficiency in the water resulting in the suffocation of the fish. The oil also forms a film over the gill filaments of fish and other aquatic animals, and prevents the exchange of oxygen and carbon dioxide between the blood of the fish or other aquatic organisms and the surrounding water. This also causes death by suffocation. The oil then acts purely mechanically and proves fatal only to those fish and other organisms which come in contact with it. Because the oil spillage in Riley Creek was partially controlled near the source of the creek, and because of the removal of most of the oil by burning, only the fish and other organisms in that part of the creek between the source and the wire fence could have been affected in large numbers. Studies conducted by Conlin and Platt (13) showed no gross downstream pollution of the Embarras River for which Riley Creek is a tributary.

The heavy siltation which occurred as a result of the placement of the fence in the stream will undoubtedly have to be cleared by dredging. If the drain tiles are to be useful and if Riley Creek is to provide a channel for the escape of excess water from the surrounding farm land, the heavy vegetation which now impedes water movement, as well as the mounds of silt will have to be cleared. The estimated cost of dredging Riley Creek, according to Ted Holmes (19) who is a commissioner on the district drainage system, is $45,000 to $50,000.

The drain tile systems in the area have also been blocked several times through other activities of the oil industry. In building roads to oil wells, often instead of using a culvert over a drain tile, the oil men will simply build over it. Later, when driving heavy equipment over these roads the tiles will break due to the heavy pressure exerted by the equipment. Heavy equipment may also break tiles in other parts of the field if the oil men have to leave the roads for some reason. Another way in which tiles may be damaged is when oil companies are laying oil pipe in a field, they may cut through the tiles. The cost of replacing these tiles is not much if the farmer can find the damaged area and he does the repair himself. If, on the other hand, he has to hire someone to repair the tile, it may lead to considerable expense.

The loss of land available to the farmer due to oil industry activities, in some cases, is high. Holmes (19) for example, farms 240 acres but 17 acres cannot be farmed because of roads, storage tanks, wells, and discarded junk in his fields. Considering this, plus the fact that eight acres of his corn are ruined due to an oil leak, he has lost approximately 10.4% of his tillable farm land. When one projects this further, at an average of 130 bushels of corn per acre at $1.10 per bushel, he has not realized $3,575 worth of profit on his farm land. His lease for oil pays him approximately $100 per month or $1200 a year. This shows a total loss of $2,375 per year.

Blume estimated that of the 500 acres he rents, six acres are not farmed because of oil activities. Since he rents his farm (this farm is in a trust at a bank in Mattoon), the owner receives the monies from the lease of the farm to the oil people. The six acres of oil land he has to pay rent on. He thus loses $858 per year on these six acres using the same figures as in the Holmes case.

In talking to several farmers in the area and the state oil inspector, the author found that one reason oil companies were negligent in paying for damages is because oil wells are about played out. The oil companies cannot afford new equipment nor can they afford to pay damages. Since worn out equipment is often being used, the possibility of more oil leaks is great.

In addition to the direct biological effect of the escape of crude oil into streams and into crop lands, the potential biological harm to the soil should be considered. Table I shows that invertebrate populations were greatly reduced in an area where oil was spilled. The ecological effects are obvious. If oil soaked soil can not support plants (producers), then herbivores and carnivores will not be found there either. The insects in the area were obviously not permanent residents of the oil soaked location. They were simply transient organisms.

Oil is not toxic to soil as such. The damage oil does is to prevent plants from obtaining sufficient moisture and air. Depending on the extent of saturation, oil soaked fields may be reclaimed from 1 to 2 to several years following contamination. At first a decreased stand is almost inevitable. The decrease is due to water relationships in the soil whereby the plants are unable to develop root systems. Crude petroleums are converted to soil organic matter by bacteria and fungi (26). This is indicated in Table II where the oil soaked area of the corn field had organic material present at only 3.1%. During the conversion, the organisms, which are free livers, fix fairly large amounts of atmospheric nitrogen in their substances. Later this nitrogen becomes available for plant growth and the organic matter improves soil physical condition (26). The effects of oil pollution on soil, therefore, are temporary.

The effect of salt water pollution on soil seems to be more permanent than oil pollution. In this study, the area covered with salt water in the clover field had been in the same condition for four years. The soil which had the salt water leak had a sodium soil test value of 13,203 ppm compared to the control value of 80 ppm. Soluble salt was 55 millimoles/cm^3 compared to 1.4 millimoles/cm^3. According to Dr. Peck (25), normal levels of sodium and soluble salts are less than 100-200 ppm Na and 2 millimoles/cm^3 respectively. Sodium in excess of 450 ppm is excessive. Soluble salts in excess of 16 millimoles usually restrict the growth of most plants except for a few very tolerant crops. Salt has a plasmolyzing effect on plants and thus none appear in this area (Fig. 19). Also, very few decomposers are capable of breaking salt down so the soil would be capable of supporting plants.

Because of the absence of plants in this area, as in the case of the oil spill, no herbivores would be found. This is substantiated in Table I where a total of only seven insects were found out of ten samples. These insects were leafhoppers and they were only passing through this area.

Table II indicates that the area of cornfield soaked with oil also had a relatively large sodium soil test value. This is explained easily because when oil is produced, usually salt water is produced at the same time. The oil which soaked the corn field had not yet gone to a separating battery to remove the salt water from the oil.

Two and a half years after the original oil leak into Riley Creek, an oil scum could still be observed and the odor of oil was evident. This is enough to constitute pollution even though the soil analysis of silt taken from the bottom of the creek does not necessarily indicate so (Table II). Perhaps, in this amount of time the creek has been flushed out during periods of heavy rain. Even so, Riley Creek will have to be dredged out before it will be in acceptable condition.

That oil is a necessity is not being questioned in this paper, but when its removal is done at the total expense of the community from which it comes, then its removal cannot be justified.

LITERATURE CITED

1. Aldrich, E.C. 1938. A Recent Oil Pollution and Its Effects on the Waterbirds in the San Francisco Bay Area. Birdlore, 40: 110-114.

2. Anon. 1971. Diesel Oil Spill at Anocortes. Marine Pollution Bulletin, 2(7): 105-106.

3. Anon. 1969. Pollution Caused Fish Kills 9th Annual Report. Prepared by Office of Public Information. Federal Water Pollution Control Administration, Washington, D.C.

4. Anon. 1969. Helpless Birds, Helpless Technology, Giant Oil Spills Coats Beaches, Both Prevention, Cure Unknown. Science News, 95(7): 183-84.

5. Anon. 1957. The Menace of Oil Pollution. Audubon Mag. 59(1): 24.

6. Anon. 1967. One Answer Shows Through the Oil Slick. Audubon Mag. 69(6): 4-5.

7. Anon. 1971. Oil Spill Technology Makes Strides. Enviromental Science and Technology, 5(8): 674-675.

8. Bellamy, D.J., et al. 1967. Effects of Pollution from the Torrey Canyon on Littoral and Sublittoral Ecosystems. Nature, 216: 1170.

9. Blume, Louis. 1971. Personal Interview.

10. Bourne, W.R.P. 1968. Observations of an Encounter Between Birds and Floating Oil. Nature, 219: 632.

11. Collins, C.T. 1961. Oil Pollution - Again. Jack Pine Warbler, 39(3): 129-130.

12. Condict, Sam. 1970. Personal Interview.

13. Conlin, Mike and R. Platt. 1970. Water Pollution in Coles County, Illinois. (Unpublished report to Dr. Durham, Eastern Illinois University).

14. Fisher, J. and S. Charlton. 1967. Tragedy of Errors; Effect of Torrey Canyon Diaster on Sea Life. Audubon Mag. 69(6): 72-85.

15. George, M. 1961. Oil Pollution of Marine Organisms. Nature, 192; 1209.

16. Gooding, R.M. 1971. Oil Pollution on Wake Island from the Tanker R.C. Stoner. Special Scientific Report, Fisheries No. 636.

17. Hanson, Richard. 1971. Personal Interview.

18. Hicks, J. 1967. Fair England Fouled by Oil. Life Magazine, 62(15): 26.

19. Holmes, Ted. 1971. Personal Interview.

20. Hunt, G.S. 1965. The Direct Effects on Some Plants and Animals of Pollution in the Great Lakes. Bioscience, 15(3): 181-186.

21. Lane, F.W., et al, 1924. Effect of Oil Pollution of Coastal and Other Waters on Public Health. Public Health Report, 39; 1957.

22. McCauley, R.N. 1966. The Biological Effects of Oil Pollution in a River. Limnol. Oceanogr. 11: 475-486.

23. Molotch, Harvey, 1970. Santa Barbara: Oil in the Velvet Playground. Eco-Catastrophe, 84-105. Canfield Press. San Francisco.

24. Ogren, I. and J.B. Pearce. 1968. Oil Pollution - A Threat to Marine Resources and Recreation. Underwater Naturalist, 5: 2,6.

25. Peck, Ted. 1971. Letter written to author.

26. Peterson, R.T. 1942. Birds and Floating Oil. Audubon Mag. 44(3): 217.

27. Plice, M.S. 1948. Some Effects of Crude Petroleum on Soil Fertility. Soil Science Society of America Proceedings, 13: 413-416.

28. Radcliffe, Donna R., et al. 1969. Biological Effects of Oil Pollution --- Bibliography. Federal Water Pollution Control Administration. Washington, D.C.

29. Shelford, V.E. 1917. An Experimental Study of the Effects of Gas Waste upon Fishes with Special Reference to Steam Pollution. Bull. Ill. State Lab. Nat. Hist. 11: 381-412.

30. Shoemaker, C.D. 1957. The Menace of Oil Pollution. Audubon Mag. 59(1): 24.

31. Tottenham, K. 1959. The Oil Menace. <u>Audubon Mag</u>. 61(3): 28-30.

32. Tubb, R.A. and T.C. Dorris. 1965. Herbivorous Insect Populations in Oil Refinery Effluent Holding Pond Series. <u>Limnol</u>. <u>Oceanogr</u>. 10: 121-134.

33. Walsh, J. 1968. The Wake of the Torrey Canyon. <u>Science</u>, 160: 167-169.

34. Wiebe, A.H. 1935. The Effect of Crude Oil on Freshwater Fish. <u>Trans</u>. <u>Ameri</u>. <u>Fish</u>. Soc. 65: 324-331.

APPENDIX I

The following are typical of the questions asked and the answers received from the farmers concerning the presence of the oil industry in the area.

1. Has the oil industry damaged the drainage system of your farm?

   Ted Holmes, Louis Blume, (Blake Farm), and William Homan all agreed that in several ways the oil industry had definitely damaged the drainage on their farms.

2. Does the money realized by the lease to oil producers on your farm make up for the loss of profits on the land used by the oil industry?

   All the farmers talked to seemed to think they could make more money if they could farm the land used by the oil companies.

3. Do the oil companies pay damages for injury to soil and crops due to the presence of oil operations?

   The farmers said they were supposed to receive money but, except for the Duncan producers (Oliver Farm), they very seldom actually received any damages.

4. How many years will it be before the land flooded with oil and saltwater become productive?

   Louis Blume said he has some land that was flooded with saltwater about six years ago and still it will not grow anything. Ted Holmes had some land flooded with oil and he thought it would be at least five years before crops would grow on it.

5. How cooperative are the oil men with the farmers?

The general answer was that the oil men do as they please. If they feel like putting in a road anywhere, they do it. They drive their heavy trucks over crops tearing out corn and beans. Many times in putting in oil pipes, they dig through drain tiles and do not repair them.

6. Why is it a problem in receiving money for damages?

The oil fields here are about played out, and the only way the oil industry can make money is by trying to keep overhead to a minimum. So instead of replacing worn equipment, they simply try to repair it. It's very hard to get them to pay damages for anything.

7. How many acres is this farm and how much of it do you not farm because of oil operations?

Blume-- A 500 acre farm but 6 acres not farmed because of oil operations.
Holmes--A 240 acre farm but 17 acres not farmed because of storages tanks, roads, wells, etc. , and 8 acres lost due to an oil spill. Total of 25 acres lost.

8. How much will it cost to dredge Riley Creek to make the drainage system of the farmland effective?

Ted Holmes, a commissioner on the district drainage system, said the cost would be $45,000 to $50,000.

9. How did the oil leak occur?

Sam Condict- Producer on the Oliver farm. Everyone thought the leak had occurred on the Oliver farm since that is where the drain tile came from. Condict's men followed the tile with probes and finally found the leak on the Homan farm. Here Jim Shafer was the producer. It took about three weeks to find the leak.

10. How bad was the leak?

Richard Hanson- State oil inspector. He said there was a little oil but nothing to amount to anything. Beside that, the oil was burnt off every morning so nothing was damaged seriously. Sam Condict said that after the leak was stopped, oil production on the well that was leaking went up about 30 barrels a day.

11. How does the oil industry effect the area?

Richard Hanson- It is good for the people because it gives them added income from their leases every month. Several of the farmers interviewed would rather see the oil industry leave Mattoon. It is disruptive to farming practices.